DOCUMENT RESUME

ED 223 667 TM 820 791

AUTHOR Randhawa, Bikkar S.; Hunt, Dennis
TITLE Structure of Learning Environment Variables in Mathematics and English Courses.
PUB DATE Sep 82
NOTE 16p.; Paper presented at the Annual Meeting of the British Educational Research Association (St. Andrews, Scotland, UK, September 7-9, 1982).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Affective Measures; *Classroom Environment; *English Curriculum; Factor Analysis; *Factor Structure; Grade 10; High Schools; Influences; *Secondary School Mathematics; Standardized Tests
IDENTIFIERS *Learning Environment Inventory (Anderson et al); Otis Lennon Mental Ability Test; Sequential Tests of Educational Progress

ABSTRACT

The extent of congruence of the underlying factor structures of the learning environment and cognitive variables for mathematics and English courses in grade 10 are presented. The Learning Environment Inventory (LEI), the Otis-Lennon Mental Ability Test, and the Sequential Tests of Educational Progress were administered to 317 students. The students in one group (n=157) were told to complete the LEI in the context of their mathematics class, while the other group (n=160) completed the LEI in the context of their English class. For the two course contexts, a clearly distinct and specific common factor defined as the cognitive environment, or intellectual climate, factor emerged. Two other factors were defined by the LEI scales: the procedural characteristics of academic courses and a weak formative characteristic factor. Unlike the procedural and environmental factors, the pair of formative characteristics was not similar in the two courses. It would appear that the LEI factors have a structural property which is unaffected by the cognitive variable context but is sensitive to the instructional context. The LEI scales pertaining to the formative characteristics could therefore provide useful data in terms of instructional and curriculum interventions. (Author/PN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED223667

Structure of Learning Environment Variables in Mathematics and English Courses[1]

Bikkar S. Randhawa and Dennis Hunt

University of Saskatchewan

Saskatoon, Saskatchewan

S7N OWO

Phone: 343-5510

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☒ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

B. S. Randhawa

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Tm 820 791

Running Head: Learning Environment

[1]Paper presented at the British Educational Research Association Annual Conference, St. Andrews, Scotland, U.K., September 7-9, 1982

Abstract

The present study determined the extent of congruence of the underlying factor structures of the learning environment and cognitive variables for the mathematics and English courses in grade 10. Three common factors were obtained in each course. The cognitive and procedural characteristics factors in mathematics were found to be highly similar to the corresponding factors in English. However, the formative characteristics factors in the two courses were not congruent. Also, the learning environment variables as a set produced two factors which resembled the congruent properties for the two courses in the context of the cognitive variables. Implications for learning and instructional research are discussed.

Structure of Learning Environment Variables in Mathematics and English Courses

In discussing theoretical, methodological, and practical issues it has been concluded that perceptions of learning environments are useful as independent, mediating, and dependent variables (see Moos, 1979; Randhawa & Fu, 1973; Shulman & Tamir, 1973; Walberg, 1974). Reliable differences in academic subjects on a variety of social-psychological environment variables have been reported (Anderson, Walberg, & Walch, 1969; Moos, 1979; Randhawa & Michayluk, 1975; Walberg, 1969). However, the structural similarity of these variables as a function of academic courses has not been investigated. It is quite unlikely to expect structural similarity or dissimilarity on all the major social-psychological dimensions because the teaching-learning process in various academic courses have, in general, common pedagogical practices. Therefore, on general procedural dimensions structural similarities may be expected. Where differences may be expected are those characteristics on which the academic courses represent inherently unique properties. The present study was designed to study the similarity and differences of the structures of learning environment variables in mathematics and English courses.

Method

Sample

Three hundred and seventeen grade 10 students from three high schools in a small city in a western province in Canada were the subjects. All of these students were enrolled in grade 10 mathematics and English courses.

Procedure

The students from each school were randomly assigned to two groups. The Learning Environment Inventory (LEI; Anderson, 1971), the Otis-Lennon Mental Ability test (OL, Otis & Lennon, 1968), and the Sequential Tests of Educational Progress (STEP, Educational Testing Service, 1971) in Reading, Spelling, Capitalization, English Expression, Mathematics Computation, and Mathematics Basic Concepts were administered to all the students assembled in a large area within each school. However, the students in one group (N=157) were told to complete the LEI in the context of their mathematics class while the other group (N=160) completed the LEI in the context of their English class. The LEI consists of 105 Likert-type items comprising 15 scales of seven items each. These scales are identified as Cohesiveness, Diversity, Formality, Speed, Environment, Friction, Goal Direction, Favoritism, Difficulty, Apathy, Democratic, Cliqueness, Satisfaction, Disorganization, and Competitiveness. Reliablity and validity data on the LEI are given in Anderson (1971). For the analysis of data, the STEP and LEI raw scores were used, but for the OL, raw scores were converted into the corresponding deviation IQ's.

Analysis

The correlation matrices of the mathematics and English contexts for the 22 variables were computed and are given in Table 1. The mathematics

---

Insert Table 1 about here

---

correlation matrix was analyzed by the method of iterative principal components (Harman, 1967). Three principal components were retained on the

basis of the criterion of the eigenvalues of the retained components after iterations being greater than 1.0. This decision was also confirmed by Cattell's (1966) scree test. These principal components were transformed to a simple structure using the normalized varimax procedure (Kaiser, 1958).

The English course correlation matrix was also analyzed using the methods of analysis given above. Again, three principal components were retained and othogonally rotated employing the normalized varimax procedure. The three English course components were further orthogonally rotated to make this factor solution as similar as possible to the varimax factor structure obtained for the mathematics course. The procedure used for this purpose was that developed by Cliff (1966). This procedure seeks an orthogonal tranformation such that when applied to the matrix of interest the transformation produces a matrix which is maximally similar to the criterion matrix. The coefficient of congruence produced for a pair of maximally similar factors gives an indication of the extent to which two factors are similar. These coefficients are evaluated only subjectively because no statistical test of significance is available. Evans (Note 1) suggests coefficients of .90 or higher indicate "good" correspondence, coefficients from .80 to .90 show "fair" correspondence, coefficients from .70 to .80 indicate "poor" correspondence, and coeficients lower than .70 show no correspondence between a pair of factors.

An anlaysis similar to the one reported above was also made for the 15 LEI variables. This 15x15 matrix produced two common factors for each course context and were rotated by an orthogonal congruence transformation.

Results and Discussion

The communalities for the variables and the factor structures for the mathematics and English courses are given in Table 2. For the two course

---

Insert Table 2 about here

---

contexts, a clearly distinct and specific common factor, Factor I, with significant loadings on the STEP tests and the Otis-Lennon Mental Ability test, emerged. Hence, Factor I was defined as the cognitive environment or intellectual climate factor. This factor in the two courses was highly similar with a congruence coefficient of .97.

The other two common factors were defined by the LEI scales. On an examination of the loadings which are largest on any one factor, it can be seen that Factor II, in the case of the mathematics course, was defined by formality, environment, friction, goal direction, favoritism, cliqueness, satisfaction, disorganization, apathy, and democratic scales. These ten scales defining Factor II seem mostly to pertain to procedural aspects of academic courses and are probably unlikely sensitive to group interactions. On the English course a highly similar factor was obtained. One of the exceptions was that the formality scale, which had a very low communality and a low negative but highest loading on Factor II in mathematics, had an acceptable communality but did not have the highest loading in the English course. Another exception was that the difficulty scale defined Factor II in the English course but not in the mathematics course. Inspite of these exceptions, Factor II had a coefficient of congruence of .94. This indicates that Factor II, procedural characteristics, was, as expected, quite similar in the two courses.

For the mathematics course friction, cliqueness, and competitiveness had factor loadings of .62, .46, and .43 respectively on Factor III. Cliqueness emerged as a complex variable because it loaded equivalently on both Factors II and III. Also, the friction scale appeared somewhat complex because it produced the highest loading on Factor III but had a substantial loading (.50) on Factor II. Four other LEI scales, cohesiveness, diversity, speed, and difficulty, may be considered to define Factor III for the mathematics course because these scales had the highest albeit small loadings on Factor III. These low loadings are not surprising because these scales had very low communalities. Therefore, Factor III could be defined as a weak formative characteristics factor. The formative nature of this factor is evident from the fact that most of the scales underlying this factor are sensitive to group rather than individual characteristics and the characterization of these behaviors is dependent upon the past experiences of the class groups.

A weak formative characteristics factor was also obtained for the English course. For this situation, Factor III had significant loadings on diversity, formality, friction, and competitiveness. Friction again appeared to be a complex variable but it did not have the highest loading on Factor III as was the case with the mathematics course. Cliqueness and difficulty did not define this factor for the English course as they did in mathematics. These similarities and differences in this pair of factors for the two courses were confirmed by a very low coefficient of congruence (0.50).

The factor structures of the 15 LEI variables for the mathematics and English courses are given in Table 3. This analysis was done to determine whether the LEI variables would produce factor structures which are

generally similar to the LEI factors for the two courses in the context of

---

Insert Table 3 about here

---

cognitive measures. As can be seen from the results in Table 3, the two factors were almost identical to the ones reported earlier in Table 2. As indicated by a congruence coefficient of .93 between the pair of Factor I's for the two courses, the procedural characteristics factor was quite similar. The pair of Factor II's, formative characteristics, was not similar in the two courses. Hence, it would appear that the LEI factors have a structural property which is unaffected by the cognitive variable context but is sensitive to the instructional context.

In a large study involving 96 grades 8 and 11 classrooms, Randhawa and Hunt (1976) reported the factor structure stability of the LEI and cognitive variables as a function of grade level. They found, as in the present study, that the formative characteristics factor was the least stable. It would appear, therefore, that the LEI scales pertaining to the formative characteristics could provide useful data in terms of instructional and curricular interventions. At this stage, it seems that the procedural characteristics in terms of the curricula involved are virtually unchanged. Whether this stability is maintained across a larger variety of curricula has not been investigated.

Reference Note

Evans, G. T. Congruence transformation: Procedures for comparing the results of factor analyses involving the same set of variables. Unpublished manuscript, Ontario Institute for Studies in Education. 1970.

References

Anderson, G. J. The assessment of learning environments: A manual for the Learning Environment Inventory and the My Class Inventory. Halifax, Canada: Atlantic Institute of Education, 1971.

Anderson, G.J., Walberg, H. J., & Welch, W. W. Curriculum effects on the social climate of learning: A new representation of discriminant functions. American Educational Research Journal, 1969, 6, 315-328.

Cattell, R. B. The scree test for the number of factors. Multivariate Behavioral Research, 1966, 1, 245-276.

Cliff, N. Orthogonal rotation to congruence. Psychomatrika, 1966, 31, 33-42.

Educational Testing Service. Teacher's Manual for STEP Series II. Princeton, N. J.: Educational Testing Service, 1971.

Kaiser, H. F. The varimax criterion for analytic rotation in factor analysis. Psychometrika, 1958, 23, 187-200.

Moos, R. H. Evaluating educational environments. San Francisco: Jossey-Bass, 1979.

Otis, A. S., & Lennon, R. T. Otis-Lennon mental ability test: Manual for administration. New York: Harcourt, 1968.

Randhawa, B. S., & Fu, L. W. Assessment and effect of some classroom environment variables. Review of Educational Research, 1973, 43, 303-321.

Randhawa, B. S., & Hunt, D. Factors in classroom environment variables. Journal of Educational Psychology, 1976, 68, 546-549.

Randhawa, B. S., & Michayluk, J. O. Learning environment in rural and urban classrooms. American Educational Research Journal, 1975, 12 265-285.

Shulman, L. S. & Tamir, P. Research on teaching in the natural sciences. In R. M. W. Travess (Ed.), Second handbook or research on teaching. Chicago: Rand McNally, 1973.

Walberg, H. J. Social environment as a mediator of classroom learning: Journal of Educational Psychology, 1969, 60, 443-448.

Walberg, H. J. (Ed.) Evaluating educational Performance: A sourcebook of methods, instruments, and examples. Berkeley, Calif.: McCutchen, 1974.

Table 1

Correlation Matrices of Respondents in Mathematics and English Courses[a]

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1.	Reading	---	53	59	73	58	43	75	05	09	-07	-00	11	-15	-04	-16	06	03	-21	01	05	05	-02
2.	Spelling	50	---	67	63	43	37	50	13	19	-07	-04	08	-14	06	-22	07	10	-22	-09	-14	06	-14
3.	Capitalization	54	65	---	73	58	51	62	11	14	-13	-11	04	-20	06	-29	-01	10	-31	-02	-11	10	-02
4.	Eng. Expression	70	60	72	---	59	48	72	03	17	-07	-04	04	-14	07	-20	07	03	-18	02	-01	05	-02
5.	Math Comp	52	39	58	55	---	68	74	-01	-03	-11	10	09	-03	-08	-15	07	-02	-17	13	07	06	03
6.	Math Basic Con	54	27	46	53	64	---	61	11	10	-01	10	10	-04	-12	-18	11	-04	-08	22	04	07	05
7.	Otis-Lennon	78	50	60	75	65	63	---	-01	06	-15	-01	13	-14	-05	-19	08	02	-20	06	01	14	05
8.	Cohesiveness	-11	-13	-02	-05	-09	04	-07	---	02	03	-11	06	-08	21	09	-08	08	-00	05	-20	-01	05
9.	Diversity	-13	-00	13	-04	04	06	-06	09	---	18	08	01	24	10	-14	14	-03	09	08	-13	-12	25
10.	Formality	-05	-03	-06	-00	-11	-02	-02	06	20	---	14	14	13	31	-01	-07	02	-12	29	-10	02	15
11.	Speed	-15	-07	-18	-10	-20	-21	-15	-10	-10	12	---	-22	28	-21	22	07	-35	32	31	24	-22	15
12.	Environment	-12	-19	-07	-12	-09	08	-10	19	22	19	13	---	-12	30	-24	-07	41	-33	-08	-25	34	03
13.	Friction	-35	-15	-14	-22	-15	-16	-27	09	13	03	-05	-09	---	-17	18	44	-40	52	18	34	-30	34
14.	Goal	00	-06	-09	-07	04	-04	-03	-03	07	25	-08	29	-18	---	-23	-23	41	-37	-16	-34	25	-03
15.	Favoritism	-28	-11	-25	-19	-27	-22	-24	08	-00	09	11	-09	26	-32	---	10	-35	35	12	29	-44	09
16.	Cliqueness	-22	-08	-05	-10	-03	-04	-13	-12	14	05	-02	-10	61	-18	18	---	-37	36	09	25	-23	28
17.	Satisfaction	09	-09	02	-01	02	13	07	06	02	14	-32	33	-10	31	-31	-11	---	-54	-35	-53	44	-17
18.	Disorganization	-20	-01	-05	-09	-07	-07	-16	00	12	19	07	-22	36	-42	33	32	-48	---	25	45	-38	19
19.	Difficulty	04	07	06	08	08	-02	11	-26	-01	14	45	-10	-15	-02	-16	-07	-30	04	---	24	27	18
20.	Apathy	04	08	10	10	15	02	12	-02	-10	24	-04	-17	27	-37	13	25	-28	37	05	---	-28	10
21.	Democratic	23	15	23	18	24	24	27	-14	22	02	-18	03	-25	20	-43	-20	17	-19	02	13	---	-17
22.	Competitiveness	-15	-15	-17	-16	-02	03	-08	03	16	23	06	09	45	05	14	33	02	11	-02	10	-01	---

[a]The lower triangular matrix is for mathematics and the upper triangular matrix is for English

Table 2

Criterion Factor Loading Matrix (Mathematics) and Congruent Orthogonal Factor Matrix[a] (English)

	Subtests/Scales	Mathematics				English			
		h^2	I	II	III	h^2	I	II	III
1.	Reading	67	78	-10	-21	62	78	03	-07
2.	Spelling	42	61	12	-18	45	67	-09	-01
3.	Capitalization	61	78	06	-03	66	81	-10	-05
4.	English Expression	72	83	06	-15	71	84	01	00
5.	Math Computation	56	74	01	04	61	77	12	-04
6.	Math Basic Concepts	50	69	-08	14	46	67	12	08
7.	Otis-Lennon	76	87	-03	-11	76	87	05	-07
8.	Cohesivness	05	-07	-07	19	03	06	-12	11
9.	Diversity	10	03	-05	30	23	14	04	46
10.	Formality	07	-08	-21	12	30	-09	-12	53
11.	Speed	22	-25	17	36	22	-02	43	17
12.	Environment	26	-09	-42	28	24	13	-44	19
13.	Friction	69	-22	50	62	48	-15	53	42
14.	Goal Direction	35	-04	-58	09	41	00	-56	31
15.	Favoritism	27	-31	41	07	27	-27	43	07
16.	Cliqueness	43	-08	46	46	23	07	44	18
17.	Satisfaction	49	09	-61	33	63	06	-79	-03
18.	Disorganization	48	-11	68	07	57	-26	71	09
19.	Difficulty	15	03	11	-37	22	05	37	29
20.	Apathy	30	13	53	06	41	-04	63	-11
21.	Democratic	20	32	-32	01	31	11	-54	-09
22.	Competitiveness	22	-11	14	43	25	01	24	44
	Total Variance	849	462	244	144	909	461	332	155
	Congruence Coefficient						97	94	50

[a]Decimal points are omitted.

Table 3

Criterion Factor Loading Matrix (Mathematics) and Congruent Orthogonal Factor Matrix[a] (English) for the Learning Environment Inventory Scales

Scale	Mathematics			English		
	h^2	I	II	h^2	I	II
1. Cohesiveness	04	-01	20	02	-09	13
2. Diversity	09	-01	30	21	16	43
3. Formality	08	-16	23	26	04	51
4. Speed	11	15	-30	21	45	04
5. Environment	23	-33	35	26	-39	32
6. Friction	73	64	56	48	64	25
7. Goal Direction	35	-54	23	39	-44	44
8. Favoritism	22	47	04	22	43	-20
9. Cliqueness	42	54	36	22	46	06
10. Satisfaction	49	-55	44	63	-77	19
11. Disorganization	47	68	-08	54	73	-13
12. Difficulty	13	04	-36	20	41	17
13. Apathy	24	49	-09	39	57	-27
14. Democratic	14	-37	00	32	-56	08
15. Competitiveness	24	24	43	26	35	38
Total Variance	399	258	141	462	350	113
Congruence Coefficient					93	70

[a]Decimal points are omitted.